CREEP BEHAVIOR AND STRENGTH OF MAGNESIUM-BASED COMPOSITES

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The major current area of growth for the use of magnesium alloys is in the high volume commercial automotive sector. However, the applications require a greater improvement in the high-temperature strength and resistance than is possible with the currently available commercial magnesium alloys. A considerable improvement in the creep properties of magnesium alloys can be potentially achieved by non-metallic reinforcement (metal matrix composites, MMCs). This paper provides a comparative report on experiments which were conducted on the two representative magnesium alloys (AZ91 and QE22) and their discontinuous composites in order to evaluate the creep properties and to clarify the direct and indirect strengthening effects of reinforcement in creep. A comparison between the creep characteristics of squeeze-cast AZ91 and QE22 magnesium alloys reinforced with 20 vol.% Al_2O_3 short fibers and unreinforced matrix shows that the creep resistance of the reinforced materials is considerably improved compared to the monolithic alloys. Better creep resistance arises from a load transfer effect in which part of the external load is carried by the reinforcement. Indirect composite strengthening may be caused by microstructural effects leading to a threshold stress that increases the creep resistance. By contrast, the investigations of the creep behavior of a particulate QE22-15 vol.%SiC composite prepared by powder metallurgy and the squeeze-cast hybrid QE22 matrix composite have revealed no substantial increase in the creep strength of the composites compared to the matrix QE22 alloy These results indicate a paramount importance of the choice of the composite matrix alloy and the reinforcement used.